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ANALYSIS OF FLEET AND SHORE DEMANDS ON THE NAVAL SUPPLY CENTER,--ETC(U)
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July 1976

ANALYSIS OF FLEET AND SHORE DEMANDS
ON THE NAVAL SUPPLY CENTER, SAN DIEGO

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NPRDC-TR-76TQ-39	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ANALYSIS OF FLEET AND SHORE DEMANDS ON THE NAVAL SUPPLY CENTER, SAN DIEGO		5. TYPE OF REPORT & PERIOD COVERED
6. PERFORMING ORG. REPORT NUMBER		7. CONTRACT OR GRANT NUMBER(s)
8. AUTHOR(s) Thomas A. Blanco		9. PERFORMING ORGANIZATION NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 63707N TDP ZPN01.01		11. CONTROLLING OFFICE NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152
12. REPORT DATE Jul 1976		13. NUMBER OF PAGES 27
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 1226P.		15. SECURITY CLASS. (of this report) UNCLASSIFIED
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Input-Output Analysis Demand Forecasting Manpower Planning		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In developing a system for allocating manpower resources in the Navy, major emphasis has been ^{has been} placed on the design of an input-output model to forecast the workload of shore activities based upon the size and distribution of the fleet. In order to test the feasibility of input-output analysis for operational use, a full-scale model of the 11th Naval District is being developed. The structure of input-output analysis requires data on the work output of each shore activity and its destination in the fleet and other shore activities. In addition, the demands placed by the fleet must be disaggregated by ship type, movement, and status. → next page		

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20. ABSTRACT: (Continued)

cont.

→A major effort underway is the collection and organization of data and the empirical analysis of the fleet-shore workload demand network, focusing on 12 major shore activities in the 11th Naval District. This report is concerned with the analysis of workload demand in one of these major shore activities--the Naval Supply Center (NSC) in San Diego.

Analysis of the demand on NSC San Diego was made in terms of individual customers, the proportion of fleet demands to shore demands, the feasibility of grouping ships by type, the effect of deployment and overhaul on NSC's workload, and the stability of demand for ship and shore customers.



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FOREWORD

The analysis of fleet and shore demands described in this report is in support of a Manpower Requirements and Resources Control System (MARRCS), being developed as a subproject under Advanced Development ZPN01.01, Personnel Supply Systems. The overall objective of MARRCS is to test and evaluate technologies directed toward improved manpower resources management. The main effort in FY 1976 is the empirical study of the fleet and shore demands on major shore activities in the Eleventh Naval District, with the objective of developing an input-output model of the fleet-support demand network.

Acknowledgments are due to LCDR R. E. Lewis (Planning Department) and LCDR R. E. Osmon (Customer Services Officer) of the Naval Supply Center, San Diego, for their assistance and guidance on this project. The entire staff at NSC San Diego was extremely helpful and cooperative throughout the data collection and analysis stages of this study.

J. J. CLARKIN
Commanding Officer

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SUMMARY

Problem

In designing a system for determining manpower requirements and allocating manpower resources, major emphasis has been placed on the development of an input-output model to forecast the workload of shore activities based upon the size and distribution of the fleet. The input-output model will link the activities of the fleet elements to each individual shore-support activity, and also indicate linkages among shore-support activities. Manpower requirements will then be derived from the workload forecasts. The I/O model may be able to answer a wide variety of Navy management questions, such as, for a specified fleet size, how much manpower at each activity is needed to support the fleet?

Objective

In order to test the feasibility of input-output analysis for operational use, a full-scale model of the 11th Naval District is being developed. The structure of input-output analysis requires data on the work output of each shore activity and its destination in the fleet and other shore activities. In addition, the demands placed by the fleet must be disaggregated by ship type, movement, and status.

A major effort has been initiated to collect, organize, and analyze data which will quantitatively describe the fleet-shore workload demand network. The main effort is concentrated on 12 major shore activities in the 11th Naval District. This report is concerned with the analysis of workload demand in one of these shore activities--the Naval Supply Center (NSC) in San Diego.

Approach

The structure of demands on NSC San Diego was measured by analyzing two basic NSC data sources, the Requisition Demand History (RDH) file and the Top Fifty Customer (TFC) report. A record of all requisitions or demands placed on NSC San Diego from March 1973 to December 1974 was extracted from the RDH file. The data contain individual requisition transactions in which the demand customers are identified by unit identification codes (UICs).

Since the RDH file permits an analysis of the demand on NSC in terms of individual customers, the data can be used to analyze the proportion of fleet demands to shore demands on NSC, the feasibility of grouping ships by type, the effect of deployment and overhaul on NSC's workload,

and the stability of demand over time for ship and shore customers. If the data are included in an input-output model, along with data from other activities, then the importance of second and higher order effects can also be analyzed. Since NSC prepares data about its top 50 customers each month, the possibility of using alternative data sources to obtain approximate results was explored. The monthly TFC report was analyzed from July 1974 to December 1975.

Using the RDH file, an analysis of fleet demand by size, type, status, and movement of ships was conducted. Time studies of ship demand versus ship movement and status (e.g., ready, in overhaul) were performed. In addition, it was necessary to determine if ships of the same type have similar demand patterns. If such patterns exist, then the fleet can be represented by ship types in an input-output model and each type would have a final demand consisting of the number of ships in the type.

Findings

Although NSC San Diego serviced thousands of customers in 1974 and 1975, its demand can be adequately represented by about 200 customers. Fleet demand on NSC San Diego was found to differ significantly by ship type, ship movement, and ship status. Aircraft carriers and service ships (tenders and repair ships) made the heaviest demands on NSC San Diego. In-port ships were found to have average demand rates within their respective ship type that were higher than their average demand rates while in an overhaul status. One exception was found, however, in the case of a Supply Operations Assistance Program (SOAP) overhaul. Requisition demand was extremely high during the overhaul month when SOAP shortage requisitions were submitted to NSC San Diego.

Shore customer demand represented at least half of total demand on NSC San Diego in 1974 and 1975 and was more stable over time than fleet customer demand. Overhaul and deployment schedules are responsible for the large monthly fluctuations in fleet demand. SERVMART demand was found to represent a large (11% of total demand) indirect demand on NSC San Diego by both fleet and shore customers.

Conclusions

The analysis of the demand on NSC San Diego permits some general conclusions on the feasibility of building an input-output model of the fleet-support demand network.

1. Data exists in the supply system to measure fleet and shore activity demands on Naval Supply Centers in terms of number of requisitions, but analysis of the data proved to be considerable and time-consuming, with close working relationships with NSC staff members essential in interpreting the data.

2. NSC San Diego customer demand can be adequately represented by about 200 customers—a workable number of sectors. Whether the major customers of NSC San Diego will also turn out to be the major sectors in a more comprehensive input-output model remains to be determined.

3. For NSC San Diego, the operating forces comprise less than half the total demand. The rest of the demand is from shore customers. Consequently, any model linking the fleet to the shore must include second order effects of the fleet on an activity via other activities.

4. Since ship status and movement affected demand so significantly, the input-output model should address tempo of operations by including the effects of overhaul and deployment.

Recommendations

1. As a by-product of this analysis, it is recommended that the Customer Services Department of NSC San Diego use the results of this analysis to more accurately predict future workload levels based on projected fleet and shore customer configurations.

2. This analysis should be extended to include all six Naval Supply Centers. Such an analysis might provide the Naval Supply Systems Command (NAVSUP) with the information necessary to allocate resources throughout the supply system more equitably.

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INTRODUCTION

Problem

In designing a system for determining manpower requirements and allocating manpower resources, major emphasis has been placed on the development of an input-output model (Sorenson and Blanco, 1975, Note 1). The purpose of this model is to forecast the workload of shore activities based upon the size and distribution of the fleet and then to derive the manpower requirements from the workload forecasts. The input-output model will link the activities of the fleet elements to each individual shore-support activity and also indicate linkages among shore-support activities.

Once the fleet and shore activity linkages are identified, methods must be developed to quantitatively measure the relationship of workload demand of the operating forces and workload demand of the shore-supporting activities. By organizing Navy activities in an input-output matrix, these workload demand relationships can be quantified using historical data (Sorensen and Willis, 1975, Note 2).

The input-output model may be able to answer a wide variety of Navy management questions, such as:

1. For a specified fleet size, how much manpower at each activity is needed to support the fleet?
2. For a given personnel ceiling, how large should the fleet and supporting activities be?
3. If the fleet size is cut by some percentage, how much should each shore activity be cut?
4. If the ships are transferred from one homeport to another, what effects will the transfers have on activities at each port?
5. What effect does closing a shore activity, such as a shipyard, have on operating capabilities of the fleet?

A prototype input-output model was constructed for 28 sectors in the 11th Naval District using logistics data. Although the data were somewhat spotty and inaccurate, this model demonstrated the applicability of the input-output technique in forecasting Navy manpower requirements (Sorensen and Willis, 1975, Note 2).

Objective

In order to test the feasibility of input-output analysis for operational use, a full-scale model of the 11th Naval District is being developed. The structure of input-output analysis requires data on the

work output of each shore activity and its destination in the fleet and other shore activities. In addition, the demands placed by the fleet must be disaggregated by ship type, movement, and status. Obviously, the data requirements of an input-output model are substantial. Consequently, a major effort has been devoted to the collection and organization of data for use in determining the network of fleet-shore workload demands (Blanco, Bokesch, and Sorensen, 1975, Note 3).

The empirical analysis of workload demand is focused on 12 activities in the 11th Naval District.¹ Most of these shore activities are manpower intensive and have both direct and indirect linkages to the fleet. In addition, these 12 activities represent a wide range of functions, outputs and data problems. This report is concerned with the analysis of workload demand in one major shore activity--the Naval Supply Center (NSC) in San Diego.

NSC San Diego is responsible for supplying and supporting over 140 homeported ships and over 50 shore activities, as well as visiting U. S. Navy ships and foreign navy ships. NSC currently employs over 900 civilians. In order to manage its resources effectively and support the fleet, NSC must be able to predict its future workload levels based on projected fleet and shore demands by customer.

Based on the above, an analysis of the demand impact of the fleet by size, type, status, and movement of ships was conducted. In addition, an analysis was made of demands placed on NSC by the large shore customers in the Eleventh Naval District and other nearby districts.

¹ Aside from the Naval Supply Center, San Diego, the other shore activities include the Naval Shipyard, Long Beach; Naval Air Rework Facility, North Island; Naval Air Stations, North Island and Miramar; Naval Regional Medical Center, San Diego; Naval Training Center, San Diego; Naval Station, San Diego; Public Works Center, San Diego; Naval Electronics Laboratory Center, San Diego; Naval Electronics Systems Engineering Center, San Diego; and the Development and Training Center, San Diego.

APPROACH

Data Sources and Initial Processing

The structure of demands on NSC San Diego was measured by analyzing two basic NSC data sources--the Requisition Demand History (RDH) file and the Top Fifty Customer (TFC) report. The RDH file was obtained from NSC's Unified Data Automatic Processing System, and a record of all requisitions or demands placed on NSC San Diego from March 1973 to December 1974 was extracted. The data contain individual requisition transactions in which the demand customers are identified by unit identification codes (UICs).

Since the RDH file permits an analysis of the demand on NSC in terms of individual customers, the data can be used to analyze (1) the proportion of fleet demands to shore demands on NSC, (2) the feasibility of grouping ships by type, (3) the effect of deployment and overhaul on NSC's workload, and (4) the stability of demand over time for ship and shore customers. If the data are included in an input-output model, along with data from other activities, then the importance of second and higher order effects can also be analyzed. Since NSC prepares data about its top 50 customers each month, the possibility of using an alternative data source to obtain approximate results was explored. The monthly TFC report was analyzed from July 1974 to December 1975.

Initial data analysis consisted of aggregating all transactions by UIC. The UICs were then ranked by requisition demand frequency during the time period under study. Results indicated that NSC San Diego serviced over 5700 distinct activities and had a demand of over three million requisitions during 1974 and 1975. However, the top seven customers listed below accounted for over 38% of all demand at NSC:

1. Naval Supply Center, itself
2. Naval Air Rework Facility (NARF), North Island
3. Naval Air Station (NAS), North Island
4. Long Beach Naval Shipyard
5. Naval Air Station (NAS), Miramar
6. Naval Development and Training Center (DATC), San Diego
7. USS DIXON (AS 37), a submarine tender

The top 16 customers in 1975 represented 50% of the total demand. Of these 16 customers, seven were shore activities, six were shore-based service ships (such as submarine tenders, destroyer tenders, and repair ships), and three were aircraft carriers. Demands from the seven shore customers were approximately 73% of total demand generated by these top 16 customers. The high demand by shore customers of NSC indicates the need to consider indirect impacts of the fleet on shore activities. Figure 1 shows that 90% of total demand on NSC is placed by the first 3% of the customers.

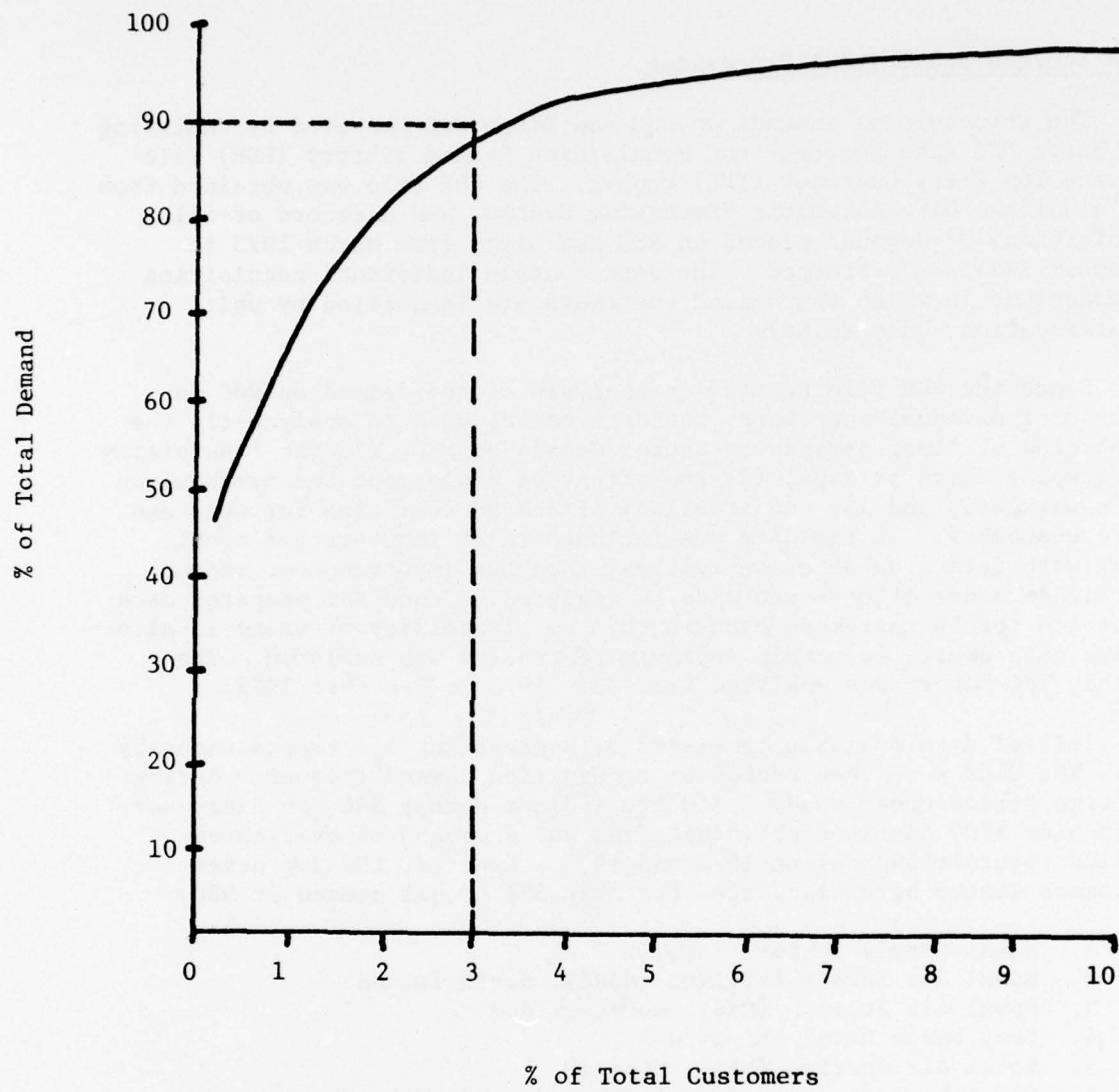


Figure 1. Customer demand at Naval Supply Center, San Diego.

The number of requisitions was chosen as the output measure for NSC, rather than alternative measures such as the dollar amount of supplies. It takes the same amount of manpower to clerically process a requisition regardless of size or cost per item. NSC also uses requisitions rather than dollars as the workload indicator for planning and management purposes. Each department at NSC, such as shipping and receiving, purchasing, and requisition processing, is measured by a requisition/man-hour level.

Analysis of Fleet Demand

Using the RDH file, an analysis of fleet demand by size, type, status, and movement of ships was conducted. Time studies of ship demand versus ship movement and status (e.g., ready, in overhaul) were performed. In addition, it was necessary to determine if ships of the same type have similar demand patterns. If such patterns exist, then the fleet can be represented by ship types in an input-output model and each type would have a final demand consisting of the number of ships in the type.

Average demand rates and standard deviations were computed for 23 ship types, encompassing 119 ships. Demand data were compiled for ships within a type by quarter. If a ship was in port for more than half of a given quarter, the quarterly data for that ship were included in the calculations.² The demand rate for a ship in a quarter was calculated by dividing the total number of requisitions during that quarter by the total number of days in port in the same quarter. The demand rates for all ships within a given type were averaged over all quarters to obtain an average demand rate for a ship of that type. Average demand rate is measured in terms of number of requisitions per day in port. Table 1 shows in-port average demand rates and standard deviations that were computed from the data for the 23 ship types.

Demand for supplies is dependent on a ship's function as well as size. An Attack Aircraft Carrier (CVA) has an average onboard population in excess of 4000 personnel, but the three CVAs homeported in San Diego during the study period had an average demand rate of only 88 requisitions/day in port. In contrast, a Submarine Tender (AS) has an onboard population of over 800 personnel, but the two ASs homeported in San Diego had a high average demand rate of 122 requisition/day in port.

²Exclusions of ship data were made to eliminate possible outliers or data extremes. In port, for our analysis, is defined as being docked or on local operations in the San Diego area.

Table 1

In Port Average Demand Rates at NSC
by Ship Type (Requisitions/Day In Port)

Symbol	Ship Type	Average Demand Rate	Std. Dev.	Number of Data Points	Number of Ships Within Ship Type
AS	Submarine Tender	122	37	18	2
CVA	Attack Aircraft Carrier	88	24	11	3
AD	Destroyer Tender	79	33	18	3
AR	Repair Ship	75	39	13	2
LCC	Amphibious Command Ship	32	2	5	1
LPH	Amphibious Assault Ship	30	6	11	3
CG	Guided Missile Cruiser	26	8	44	10
FFG	Guided Missile Frigate	21	9	11	3
LPD	Amphibious Transport, Dock	19	4	29	7
DDG	Guided Missile Destroyer	18	5	39	11
LSD	Dock Landing Ship	17	3	18	7
LPA	Amphibious Transport	17	4	7	1
LKA	Amphibious Cargo Ship	17	4	13	4
AVM	Guided Missile Ship	17	7	2	1
AOR	Replenishment Oiler	14	5	4	3
FF	Frigate	13	5	41	12
AO	Oiler	11	3	10	4
LST	Tank Landing Ship	11	3	31	10
DD	Destroyer	11	4	32	10
ASR	Submarine Rescue Ship	5	1	8	2
ATF	Fleet Ocean Tug	5	2	25	6
MSO	Ocean Minesweeper	4	1	21	6
SSN	Nuclear Submarine	4	2	18	8

In general, ships of the same type had similar demand patterns. For some ship types, there were not enough ships in the data base to conclude that all ships of a type had similar demand patterns. For example, although the Amphibious Command Ship (LCC) had a mean demand rate of 32 requisitions/day in port and a standard deviation of 2 (just 6% of the mean), the USS BLUE RIDGE was the only LCC in the data base. Other ship types, such as Guided Missile Cruiser (CG), Guided Missile Destroyer (DDG), Frigate (FF), Tank Landing Ship (LST), and Destroyer (DD), had 10 or more ships represented in the data base.

Ship types could have been grouped into classes defined by average requisition demand rate. For example, Oilers (AO), Tank Landing Ships (LST), and Destroyers (DD) all had a mean demand rate of 11 requisitions/day in port. However, it does not follow that these same ship types would fall into an identical demand group for outputs other than requisitions. As a result, ship demands will be grouped only by ship type.

The demand rates of the service ships, such as submarine tenders, must be examined more closely. Supplies to support submarines generally flow through the submarine tenders. There are presently two submarine tenders and about 16 submarines homeported in San Diego. The 16 submarines generate the workload and supply demand for the two submarine tenders.

As expected, requisition demand by a ship deployed away from the San Diego area declined to almost zero. Table 2 shows a time history of requisition demands on NSC San Diego by one ship, the USS CHICAGO, a guided missile cruiser. The period shown is from April 1973 to March 1975, illustrating periods of in-port, deployed, and overhaul status.

Demand by a ship on NSC San Diego, when it was in an overhaul status at the Long Beach Naval Shipyard, was analyzed next. A Supply Operations Assistance Program (SOAP) overhaul, whether performed at a shipyard or at dockside, can greatly affect the demand for supplies. For example, the CHICAGO underwent a SOAP overhaul from August 1972 to September 1973 at the Long Beach Naval Shipyard. NSC received SOAP shortage requisitions from the CHICAGO in May 1973. During that one month, the CHICAGO's supply demand was 21,117 requisitions or 60% of the CHICAGO's total requisition demand on NSC San Diego from March 1973 to December 1974 (see Table 2).

Examination of longitudinal requisition data indicated that when a ship was in overhaul, there was usually a single month where requisition demand was extremely high due to the submittal of SOAP shortage requisitions. During the other months of the overhaul period, however, requisition demand was generally lower than when the same ship was in an in-port status. Table 3 gives demand rates that were calculated for ships within ship types for an average in-port month, overhaul month, and SOAP shortage requisition submittal month. Ships within 17 ship types are compared.

Table 2

Time History of Requisition Demands on
NSC San Diego by USS CHICAGO (CG 11)

Month	Requisition Demand	Status
APR 73	113	Overhaul
MAY 73	21,117	Overhaul
JUN 73	939	Overhaul
JUL 73	1,112	Overhaul
AUG 73	480	Overhaul
SEP 73	475	In Port
OCT 73	2,192	In Port
NOV 73	990	In Port
DEC 73	630	In Port
JAN 74	955	In Port
FEB 74	1,526	In Port
MAR 74	928	In Port
APR 74	1,979	In Port
MAY 74	388	In Port
JUN 74	8	Deployed
JUL 74	25	Deployed
AUG 74	4	Deployed
SEP 74	16	Deployed
OCT 74	16	Deployed
NOV 74	0	Deployed
DEC 74	1,088	In Port
JAN 75	600	In Port
FEB 75	568	In Port
MAR 75	936	In Port

Table 3

**Average Monthly Demand Rates (In Requisitions)
at NSC by Ship Type and Status**

Symbol	Ship Type	In Port	Status Overhaul	SOAP
CV	Aircraft Carrier	2640	1059	13,744
LCC	Amphibious Command Ship	960	1000	No Data
LPH	Amphibious Assault Ship	900	No Data	7,660
CG	Guided Missile Cruiser	780	498	11,402
FFG	Guided Missile Frigate	630	194	5,645
LPD	Amphibious Transport, Dock	570	320	5,108
DDG	Guided Missile Destroyer	540	402	7,348
LSD	Dock Landing Ship	510	328	5,662
LKA	Amphibious Cargo Ship	510	No Data	3,188
AVM	Guided Missile Ship	510	288	No Data
AOR	Replenishment Oiler	420	420	4,530
FF	Frigate	390	201	6,662
LST	Tank Landing Ship	330	No Data	4,180
DD	Destroyer	330	164	3,860
ASR	Submarine Rescue Ship	150	No Data	3,285
ATF	Fleet Ocean Tug	150	No Data	2,561
MSO	Ocean Minesweeper	120	No Data	1,564

The difficulty of predicting monthly requisition demand when a ship is undergoing an overhaul is due to the fact that a SOAP shortage requisition submittal can occur during almost any month of an overhaul period. The data showed SOAP shortage requisition submittals occurring from as early as the second month of an overhaul period to as late as the ninth month of an overhaul period. However, a SOAP schedule is developed by the Type Commander and the SOAP team for each ship, and this information can be obtained by NSC well in advance of the SOAP shortage requisition submittal month.

Although direct fleet demand on NSC San Diego represented about 43% of total demand, the demand by shore activities on NSC accounted for an even more substantial portion of NSC's workload.

Analysis of Shore Activity Demand

Shore activity demand rates and standard deviations are shown in Table 4 for the top 20 shore customers, which represented 43% of the total demand on NSC San Diego during 1975. The percentage change in average monthly demand from 1974 is also shown for each activity.

From Table 4, it appears that NSC San Diego is its own largest customer. However, 95% of the requisition demand that appears with an NSC activity code is SERVMART demand. There are nine SERVMART stores located at the major shore activities in the San Diego area, with supplies at each store responsive to the needs of the activity where it is located. For example, the store at the Naval Electronics Laboratory Center has a high concentration of electronic parts and the one at the Naval Amphibious Base has a large inventory of boat parts.

SERVMART demand represents over 11% of the total demand on NSC. Therefore, it is critical to identify the source of demand for each SERVMART customer and its proportion of total demand. To make this determination, a 6-month line-by-line itemization of SERVMART customer demands has been requested.³ When these data become available, SERVMART demand by individual customer activity can be determined, including demands from individual ships. Direct fleet demand would then be shown to be greater than 43% of total demand, as previously cited. Including SERVMART demand, direct fleet demand on NSC should approach 50% of NSC's total demand. As an alternative approach, it may be possible to analyze customer demands at SERVMART in terms of total dollars spent. This would at least give an approximation of customer proportions at each of the SERVMARTs.

³The data, unfortunately, was not available for this report. The system which will provide the data was not scheduled for implementation until 15 September 1975, and even then the system only itemized demands at three of the nine SERVMARTs.

Table 4
 Calendar Year 1975
 Average Demand Rates at NSC by Shore Activity
 (Requisitions/Month)

Shore Activity	Average Demand Rate	Std. Dev.	% Change From 1974
Naval Supply Center, San Diego	13,894	1,883	-9
Naval Air Rework Facility (NARF), North Island	8,085	1,263	-3
Naval Air Station (NAS), North Island	6,443	1,876	+14
Long Beach Naval Shipyard	6,318	692	-39
Naval Air Station (NAS), Miramar	5,708	1,560	+11
Naval Development and Training Center (DATC)	5,151	604	-3
Naval Electronic Systems Engineering Center, S.D.	1,965	197	+9
Navy Regional Medical Center, San Diego	1,257	333	-12
Public Works Center, San Diego	1,060	237	-21
Navy Regional Medical Center, Camp Pendleton	747	216	+17
Naval Training Center, San Diego	622	158	-20
Naval Electronics Laboratory Center, San Diego	571	73	+35
Naval Station, San Diego	567	167	+6
Naval Support Activity, Long Beach	520	113	-b
Fleet Anti-Submarine Warfare Training Center, S.D.	488 ^a	166 ^a	+25
Amphibious Base, Coronado	478 ^a	161 ^a	+5
National Parachute Test Range, El Centro	472 ^a	113 ^a	-b
Plant Representative Office, Pomona, CA.	448 ^a	166 ^a	+10
Service School Command, NTC, San Diego	407 ^a	141 ^a	+13
Inshore Warfare Amphibious Group, Coronado	358 ^a	177 ^a	0

^a Estimated

^b No available data

Aside from SERVMARTs, there are five shore activities that account for a large proportion of NSC demand: Naval Air Rework Facility (NARF) at North Island, Long Beach Naval Shipyard, Naval Air Stations at North Island and Miramar, and Naval Development and Training Center (DATC). In 1975 these five shore customers had a combined average monthly demand rate of 31,682 requisitions, with a standard deviation of only 3,327 requisitions. Their demand represented over 24% of total customer demand at NSC San Diego. Also, these five customers ranked within NSC's top six customers every month in 1975.

Total demand from the top 20 shore customers decreased in the aggregate only 6% from 1974 to 1975. However, individual activity demand patterns are not stable. As shown in Table 4, demand changes from 1974 to 1975 ranged from a 39% decrease from the Long Beach Naval Shipyard to a 35% increase from the Naval Electronics Laboratory Center. The average demand change from each of the top 20 shore customers was 14%, with a standard deviation of 11%.

Top Fifty Customer (TFC) Demand

During the 18-month period from July 1974 to December 1975, the top 50 customers (TFC) averaged about 75% of the 127,208 average monthly requisitions, with a standard deviation of less than 2%. Six customers consistently represented a large portion of this TFC demand every month. These six customers are SERVMART and the top five shore customers previously discussed. The latter activities averaged 49% of the 95,110 average monthly TFC requisitions, with a standard deviation of less than 5%.

Within the TFC, fleet demand averaged about 35,000 requisitions a month during FY 1975, with a standard deviation of about 7,000 requisitions. The volume of fleet demand is dependent on the number, types, and duration of ships in port or operating locally in and around San Diego in a given month and the number of ships in overhaul. For example, in August 1974, fleet demand within the TFC was 28,904 requisitions. In October 1974, just 2 months later, the fleet demand reached 40,706 requisitions, a 41% increase. Upon closer inspection of the data, 32 ships were found to be among NSC's TFC in October 1974, and only 24 ships were found to be among the TFC in August 1974.

The customer variability within the monthly TFC demand during 1975 was also analyzed. There was an average of 35 ships a month among the TFC during 1975. However, only two ships that were among TFC in January 1975, remained within the TFC in the next 11 months. The amount of fleet demand did not depend on the number of ships in the TFC as much as on the type and status of ships represented. For example, in October 1975 35 ships were among the TFC and had a total demand of 69,372 requisitions. In December 1975 38 ships were among the TFC, but their total demand was only 35,335 requisitions. Fleet TFC demand from October 1975 to December 1975

decreased by over 49% or 34,037 requisitions. Six ships submitted SOAP shortage requisitions in October, which represented a total demand of over 32,000 requisitions, while no ships submitted SOAP shortage requisitions in December. Thus, predicting fleet requisition demand by ship type, movement, and status, as well as number of ships, will produce more accurate results than by just considering individual customer demands or number of ships.

Shore customers within the top 50 were much more consistent than fleet customers. An average of 15 shore customers appeared in the TFC monthly reports during 1975. Nine shore customers appeared in the TFC every month during this 12-month period, with an average monthly demand rate of 49,881 requisitions and a standard deviation of 4,755 requisitions. These nine shore customers represented over 92% of the shore TFC demand. Consequently, unlike fleet demand, shore demand can be predicted accurately by concentrating on relatively few activities.

Based on this analysis of the TFC file, it appears that the total requirements on the NSC may be approximated by an examination of the TFC and an analysis of the requirements of ship types. Such an approximation would be useful to a workload forecasting model, since it would cut down the data collection effort.

Total Demand and Manpower

In order to forecast manpower requirements, it is necessary to relate total demand on NSC San Diego, in number of requisitions, to the manpower necessary to satisfy that demand. In 1975, total demand at NSC San Diego was 1,555,132 requisitions, a 2.0% decrease from 1974. Civilian employment at NSC San Diego from 30 June 1974 to 30 November 1975 decreased 2.5%, so there seems to be some relationship between total requisition demand and total civilian manpower at NSC San Diego, at least in 1974 and 1975. However, like most Navy activities, NSC San Diego is not entirely demand-driven. Fiscal constraints are placed on all NSCs by the Naval Supply Systems Command (NAVSUP). Often, the budgets of shore activities are cut regardless of increasing or decreasing demands.

FINDINGS

1. Although NSC San Diego services thousands of customers each year, the monthly top 50 customers represented an average of 75% of total demand in 1974 and 1975. Moreover, about 90% of total requisition demand was represented by only 3% of NSC's customers.

2. Fleet demand was found to differ significantly by ship type. Aircraft carriers and service ships (tenders and repair ships) made the heaviest demands on NSC San Diego.

3. Ship movement was also found to be an important demand factor. When a ship was deployed to the Western Pacific (WESTPAC), demands placed on NSC San Diego were found to be negligible.

4. Ship status was found to affect demand significantly. In-port ships were found to have average demand rates within their respective ship type that were higher than their average demand rates while in an overhaul status. However, ships undergoing a SOAP overhaul had 1 month during their overhaul period when requisition demand was extremely high. That was the month when SOAP shortage requisitions were submitted to NSC San Diego.

5. Shore customer demand represented at least half of total demand on NSC San Diego in 1974 and 1975. In fact, the six largest demand customers of NSC San Diego in 1975 were all shore customers, representing over one-third of total demand.

6. Shore customer demand was more stable over time than fleet customer demand. Overhaul and deployment schedules are responsible for the large monthly fluctuations in fleet demand.

7. SERVMART demand represents a large indirect demand on NSC San Diego by both fleet and shore customers. There are nine SERVMART stores located at major shore activities in the San Diego area. The SERVMART at NAS-North Island services not only the air station but also the NARF, aircraft carriers, and other ships docked at North Island. Transient squadrons are also sometime customers.

CONCLUSIONS

The analysis of the demands on NSC San Diego permits some general conclusions on the feasibility of building an input-output model of the fleet-support demand network and some specific conclusions concerning the management of NSC San Diego's workload.

1. Data exists in the supply system to measure fleet and shore activity demands on Naval Supply Centers in terms of number of requisitions. These data fit the input-output framework well. However, analysis of the data proved to be a considerable and time-consuming task. Close working relationships with members of NSC's Planning and Customer Services' staff were essential in interpreting the data.
2. In building an input-output model of the fleet-support demand network, the number of sectors that can be effectively handled is an important question. Although NSC San Diego has over 5000 customers, its demand is adequately represented by about 200 customers--a workable number of sectors. Whether the major customers of NSC will also turn out to be the major sectors in a more comprehensive input-output model remains to be determined.
3. For NSC, the operating forces comprise less than half the total demand. The rest of the demand is from shore customers. Consequently, any model linking the fleet to the shore must include second order effects of the fleet on an activity via other activities. If these second order effects are not included explicitly or implicitly (as in an input-output model), then the effects of changes in the operating forces will be underestimated.
4. Since ship status and movement affected demand on NSC so significantly, the input-output model must not ignore the effects of overhaul or deployment. Tempo of operations may be addressed by having the I/O model include these effects.
5. The results of this study will be used to develop input-output coefficients for the NSC San Diego sector of the input-output model. The results will be used in combination with other results from analysis of demands on other major shore activities. For example, the input-output coefficient between the Long Beach Naval Shipyard and NSC San Diego might be measured in units of requisitions/man-hours of repair.

RECOMMENDATIONS

1. As a by-product of this analysis, it is recommended that the Customer Services Department of NSC San Diego use the results of this analysis to more accurately predict future workload levels based on projected fleet and shore customer configurations. More accurate prediction of future workload will allow for more opportunity to efficiently manage resources at NSC San Diego.
2. This analysis should be extended to include all six Naval Supply Centers. Such an analysis might provide the Naval Supply Systems Command (NAVSUP) with the information necessary to allocate resources throughout the supply system more equitably.

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